Quan-Tech LABORATORIES, INC.

INSTRUMENTS • AMPLIFIERS • NOISE INSTRUMENTATION

TEST EQUIPMENT COPY

INSTRUCTION MANUAL
MODEL 303
WAVE AND NOISE
SPECTRUM ANALYZER

FOR SERIAL # 521

Quan-Tech LABORATORIES, INC.

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

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CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

WARRANTY

Quan-Tech Laboratories, Inc. warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electronic tubes and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misadjustments, misuse, or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

Calibration checks of this instrument can easily be made in accordance with the instruction manual. Routine readjustments should never be attempted. If, however, the instrument has been damaged and requires recalibration or alignment, explicit calibration procedures as defined in the instruction manual must be followed.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.

2. On receipt of shipping instructions, forward the instrument prepaid, to the factory. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

SHIPPING

The instruments should be packed in their original containers, or in a strong exterior container and surrounded by two inches of shock absorbing material.

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GENERAL

The Model 303 is an all-transistorized unit incorporating a number of new features that greatly increase the usefulness of this instrument and extend its applications into the fields of ultrasonics and noise spectrum analysis. Covering frequencies up to twice as high as competitive units, it will measure the harmonics of the majority of ultrasonic transducers.

A switch selects any of four (4) constant bandwidths. The two broadest positions are flat topped, greatly increasing the simplicity and accuracy of noise measurements, and facilitating tuning at high frequencies. The sharpness of the narrow band positions is adequate for practically all applications.

SPECIFICATIONS

FREQUENCY:

Range: 30 cycles to 100 Kc.
Dial Calibrations: Approximately exponential.
Accuracy ±5% or 10 cycles.

Vernier Frequency Dial: ± 300 cycles.

SELECTIVITY:

Four fixed bandwidths available by selector switch.

Round Top Synchronous Tuned

10 cycles (± 5 cycles) at 3 db points
30 cycles (± 15 cycles) at 3 db points

Flat Top (Butterworth Approximation)

100 cycles (± 50 cycles) at 3 db points.
Approximately 2% down at ± 25 cycles
1000 cycles (± 500 cycles) at 3 db points.
Approximately 2% down at ± 250 cycles

MODEL 303
WAVE AND NOISE SPECTRUM ANALYZER

VOLTAGE:

Range:	100 μv to 300 volts full scale
Input Attenuator:	.1, 1, 10, 100, 1K plus a 20 db continuously variable attenuator.
Meter Attenuation:	1, 3, 10, 30, 100, 300 millivolts
Accuracy:	5% of full scale.
Spurious Modulation Products and Hum:	More than 70 db down.

INPUT IMPEDANCE:

100K ohms or 1 megohm with 10 to 1 attenuation.

METER CIRCUIT:

Average type calibrated RMS for sine wave. Linear for instantateous peaks 20 db in excess of full scale for accurate noise analysis. Meter movement diode protected. Time constants of approximately .01 and 1 second provided by front panel switch.

ANALOG OUTPUT:

0 to 1 volt positive proportional to meter deflection. Minus 20 volts to 0 volts approximately, proportional to tuning dial angle from 0 cycles to 100 Kc.

POWER:

105 to 125 volts AC, 50-400 cycles, 6 watts,
210 to 250 volts AC, 50-400 cycles, 6 watts, or
30 to 50 volts DC, approximately 90 ma

DIMENSIONS:

Height 11", Width 15", Depth 11-1/4" overall. Weight 28 pounds.

SECTION I

OPERATING INSTRUCTIONS

A thorough understanding of an instrument and the principal of operation greatly enhances its usefulness. Section II on Theory of Operation will familiarize the user with the instrument.

For initial operation of the instrument the following procedure should be used:

1. a. For AC operation plug the power cord into a suitable AC power source. Refer to the plate on the rear of the instrument near the power cord for the voltage and frequency for which this instrument is wired. See Section IV for instructions on how to change the input voltage.

   b. For DC operation connect a 30-50 volt DC source to the binding posts on the rear of the instrument. OBSERVE POLARITY. No switch is provided for DC operation and the instrument will operate as long as the DC source is connected. The pilot light and calibrating reference signal will also be inoperative in DC operation.

2. Set the controls as listed:
   a. MILLIVOLTS FULL SCALE - 100 or 300
   b. Meter time constant - FAST
   c. BANDWIDTH - 10
   d. METER MULTIPLIER - X 10
   e. GAIN - clockwise
   f. VERNIER Tuning - 0
   g. Main Tuning - Zero cycles.

3. Adjust the ZERO BEAT for maximum deflection of the meter.

4. Null should be less than 1/10 full scale on 100 setting. If not, balance with screw driver adjustments (upper right of main dial). The nulling is simpler if done in the 1000 cycle bandwidth position. Recheck zero on 10 cycle bandwidth after nulling.

5. Set the METER MULTIPLIER to a range higher than the signals to be measured.

6. Connect the signal to the INPUT terminals X1. The black terminals are both chassis ground. For an input impedance of 1 Meg the X10 terminal should be used.
   Note -- there is a 10:1 gain reduction on the X10 terminals.

7. The instrument is now ready for operation. The signals may be analyzed by tuning the main tuning dial and peaking on the frequency of the signal in question.

VOLTAGE CALIBRATION

The meter is calibrated in millivolts full scale as selected by the MILLIVOLTS FULL SCALE switch. To obtain an absolute voltage measurement the reading in millivolts should be multiplied by the METER MULTIPLIER position and the INPUT used with GAIN control full clockwise.

CAUTION: The entire frequency range of the Model 303 should be scanned to make sure no signals are present with an amplitude greater than full scale on the 300 millivolt position of the MILLIVOLTS FULL SCALE switch. If signals appreciably greater than full scale on the 300 millivolts position are present, a higher (less sensitive) position on the METER MULTIPLIER switch should be used. Never try to obtain greater sensitivity, after checking the above, by going to a lower (more sensitive) position on the METER MULTIPLIER switch, since the preamplifier will be overloaded and spurious responses will result.

If the GAIN control is turned fully counter-clockwise the input circuit with its attenuator is disconnected and a standard signal of line frequency and equal to a meter deflection of 100 mv. is applied. This provides a quick check on the calibration of the instrument and enables a precise frequency adjustment for the low frequencies. Make sure the unit is tuned to the line and not to its image frequency. If an equal signal at 3 times the line frequency is found, the instrument has been set to the image.

VARIABLE GAIN

To make relative measurements such as harmonic or intermodulation distortion measurements the GAIN control may be adjusted to give a convenient value for the fundamental. The harmonics then can be read directly in percent or db.

BANDWIDTH

The Quan-Tech Model 303 has the unique feature of four selectable constant bandwidths. This enables operation with a bandwidth most suitable for the analysis at hand. Bandwidths of 10 and 30 cycles enable accurate measurement in the low frequency spectrum and of modulation side-bands at higher frequencies. The 100 and 1000 cycles flat topped band passes are ideal for noise measurements and rapid signal analysis. Figure 1 gives the selectivity characteristics of the four bandwidths.

VERNIER TUNING

A fine tuning vernier is provided giving tuning deviation of ±300 cycles about the center frequency of the main tuning dial. This feature enables precise measurement of closely spaced signals in the higher frequency range.

TIME CONSTANT

Meter time constants of approximately .01 sec. and 1 sec. are selectable by the FAST and SLOW positions of the switch directly under the meter. Normally the instrument should be used with the switch in the FAST position, however, when noise measurements are being made the SLOW position will result in easier to read and more accurate measurements.

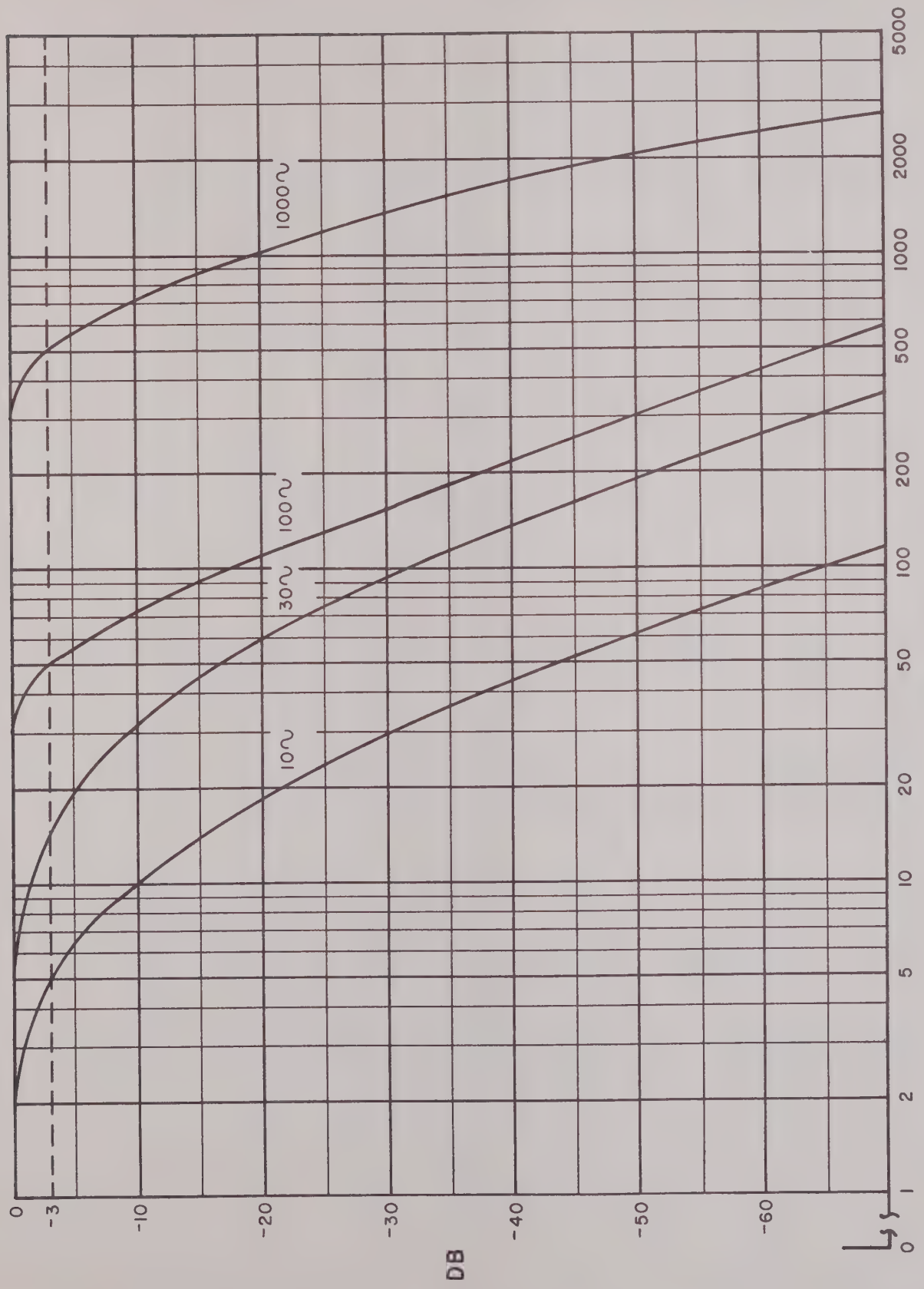


Figure 1
TYPICAL HALF-BAND RESPONSE

SECTION II

THEORY OF OPERATION

The Model 303 Wave and Noise Spectrum Analyzer is a completely transistorized instrument. The fundamentals of operation are shown in the simplified block diagram in Figure 2.

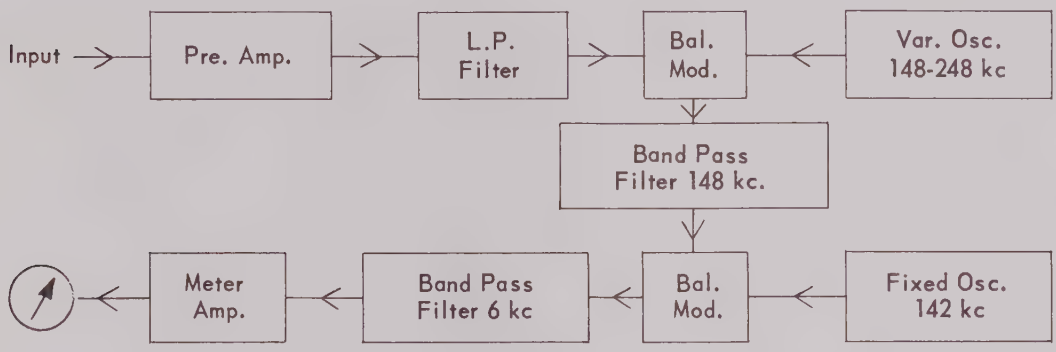


Figure 2. SIMPLIFIED BLOCK DIAGRAM

A signal to be analyzed is fed into the pre-amplifier which provides a high impedance for the source and matches the low pass filter. This filter rejects frequencies above 100 Kc, thus eliminating direct feed through of signals at the I.F. frequency and image signals.

The variable frequency oscillator is adjusted to a frequency 148 kc above the incoming signal giving a difference or I.F. frequency of 148 kc. Careful balancing of the modulator suppresses the oscillator carrier and allows operation of the oscillator at frequencies which are not completely rejected by the pass band.

Since filters having the desired bandpass characteristics are impractical at 148 kc, it is necessary to reconvert to 6 kc. This is done with a second balanced modulator and a fixed frequency oscillator of 142 kc. The 148 kc bandpass filter preceeding the second modulator rejects the image and harmonic frequencies generated by the first modulator.

The final bandpass filters operate at 6 kc where the desired bandpass characteristics are obtained. A detailed discussion of this filter, as well as the other sections, is found in Section III, Circuit Analysis.

Instantaneous overloads of approximately 10 to 1 are provided for in the meter amplifier and detection circuit. Overload levels of this order are required if accurate noise measurements are to be made.

Shown in the Block Diagram, Figure 3, are three monitor outputs. Two outputs are proportional to the meter deflection and to the angular position of the main tuning dial. Thus a graphical display of the frequency spectrum can be obtained with an oscilloscope or x-y recorder. The third is a monitor of the 6 kc I.F. carrier.

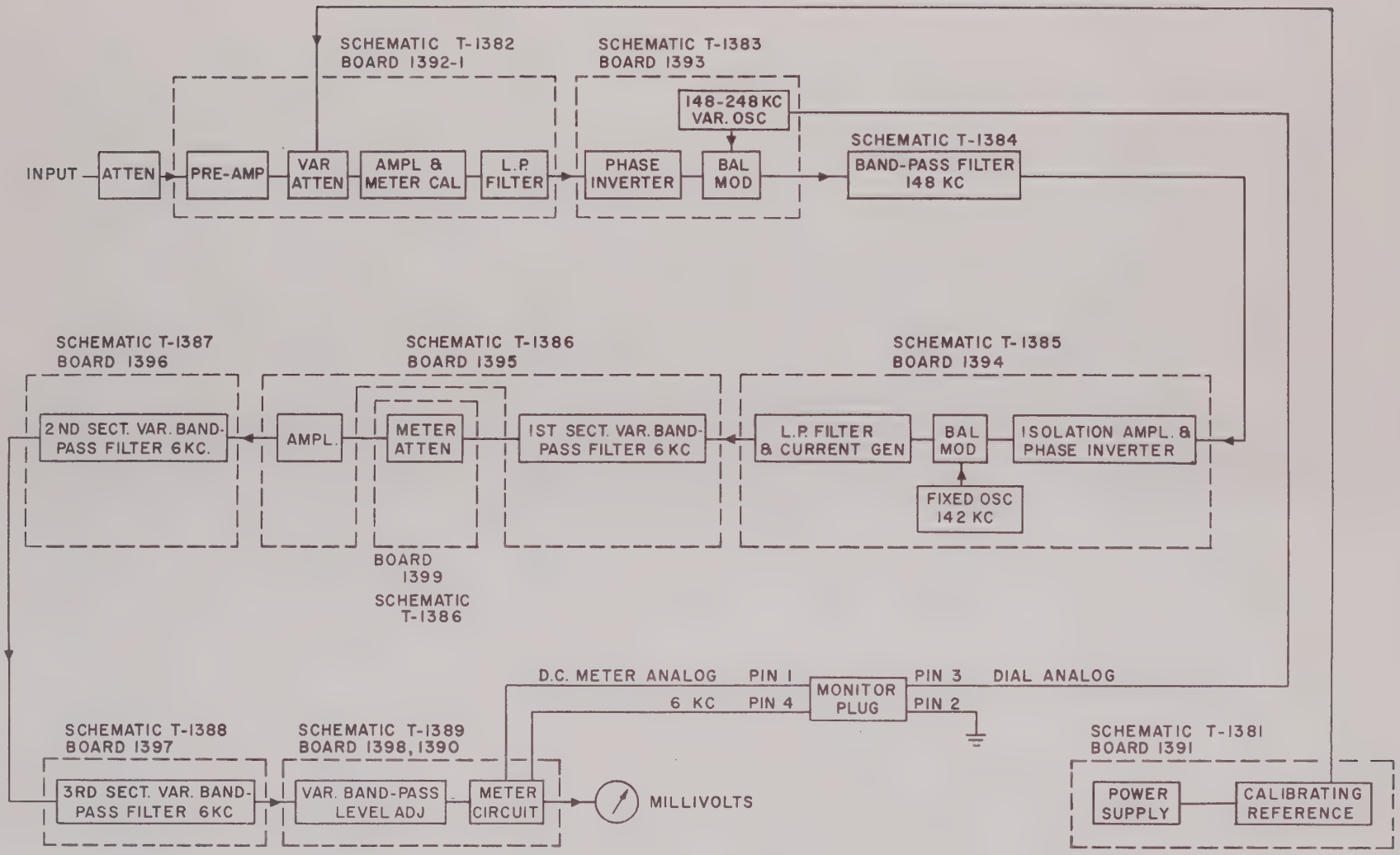


FIGURE 3
DETAILED BLOCK DIAGRAM

SECTION III

CIRCUIT ANALYSIS

Figure 3 is a detailed block diagram of the Model 303 Wave and Noise Spectrum Analyzer. Each function of the circuit is represented by a block. Blocks found on the same printed circuit board are grouped together and are identified as to their board and schematic diagram. The location of the boards and the alignment adjustments are shown in Figures 6, 7, and 8.

POWER SUPPLY - Board #1391

The regulated power supply for the Model 303 is connected to the power line through T 101, F 101, and S 101 (front panel switch). Line frequencies from 50 to 400 cycles and voltages from 105 to 125 volts rms will give satisfactory performance. A partially filtered unregulated negative voltage is supplied by rectification and filtering of T101s secondary voltage (CR101, CR102, C101). A voltage reference is supplied by a Zener diode CR103. The error voltage detected at the base of Q104 is amplified by the emitter coupled pair (Q104, Q103) and Q102. This amplifier controls the pass power transistor Q101. Regulated output voltages from -24 to -26 volts are reasonable.

CALIBRATING REFERENCE - Board #1391

An a.c. voltage reference for a calibration check and alignment at the line frequency is generated by a standard lamp bridge. R110 and R114 form the fixed legs of the bridge while two lamps form the voltage sensitive legs. The proper reference voltage is obtained by an adjustable resistance divider. A reference voltage of approximately 9.5 mv is required. Variation with line voltage should not exceed ±1% of the value at nominal line.

INPUT ATTENUATOR

The input attenuator operated by the METER MULTIPLIER control, S201, is a 100 K ohm ladder type. In position X.1 the attenuator is switched out of the circuit and the input is connected through a 0.5 mf 600 V blocking capacitor to the pre-amplifier which also has a 100 K ohm input impedance. A 1 Meg ohm input is provided with a 10:1 attenuation by R202.

PRE-AMPLIFIER - Board #1392

Transistors Q201 and Q202 with complete feedback and having unity voltage gain provide isolation and a high input impedance. R216 controls the amount of positive feedback to the base biasing network R210 and R213 and is adjusted to make the input impedance effectively 100 K ohm. Diodes CR201 and CR202 protect the input circuit from severe overload.

VARIABLE ATTENUATOR

The potentiometer, R218, serves as a variable gain control and has a maximum attenuation of 11:1. At the extreme counter-clockwise position, the pre-amp is switched out of the circuit and the calibrating reference is inserted for a check on the remainder of the circuitry.

AMPLIFIER AND METER CALIBRATOR - Board #1392

Maximum negative feedback is applied around Q203 and Q204 giving a low output impedance and minimum distortion. The voltage gain is adjustable by R226 (available at back of instrument) from approximately 4 to 7.

LOW PASS FILTER - Board #1392

A constant K filter having a cut-off frequency of 125 kc removes signals outside the band of the instrument, thus eliminating problems of feed-through and images.

PHASE INVERTER AND BALANCED MODULATOR - Board #1393

Q301 and Q302 are unity voltage gain amplifiers which supply signals 180° out of phase to the bases of the top transistor pair (Q303, Q304) of the balanced modulator. Q305 and Q306 are gating transistors driven by the variable oscillator which alternately switch Q303 and Q304 from one linear amplifier gain condition to another. R320 (100 ohms) provides a balance adjustment for Q303 and Q304. R324 and C308 provide a balance adjustment for the gating transistors.

VARIABLE OSCILLATOR - Board #1393

A two terminal emitter coupled negative resistance oscillator operating from approximately 148 kc to 248 kc provides the drive for the first balanced modulator. The difference frequency of the incoming signal and the variable oscillator is 148 kc. The frequency determining tank circuit and its tracking adjustments is covered in Section IV, Maintenance and Calibration.

148 kc FILTER

A four section Butterworth or maximumly flat filter operating at approximately 148 kc might best be considered as the 1st I.F. The filter has its -3 db points at ±1.5 kc and is flat within ±1% for approximately ±1 kc from center. Stable and dependable components have been used and adjustment is not recommended unless ABSOLUTELY necessary and then only as outlined in Section IV.

ISOLATION AMPLIFIER AND PHASE INVERTER - Board #1394

Transistor Q501 doubles as an isolation amplifier as well as a terminating impedance for the 148 kc filter. Since the collector and emitter resistances are equal, their voltages are equal and 180° out of phase. Therefore the collector to base feedback resistance appears as 1/2 its actual value and offers a proper termination. The phase inverter Q502 splits the 148 kc signal to drive the 2nd balanced modulator.

2nd BALANCED MODULATOR - Board #1394

The second balanced modulator Q503, Q504, Q505 and Q506 operates in the same manner as the first. Balance controls are omitted since complete rejection of the carrier is not required.

FIXED OSCILLATOR - Board #1394

The fixed oscillator is basically the same as the variable oscillator with the exception of the frequency determining capacitors. The frequency of operation is 6 kc below the 148 kc bandpass filter or at 142 kc. Deviation of ±300 cycles is obtained by the VERNIER control (C507). C509, the ZERO BEAT control, gives a slightly greater deviation and allows alignment of the low frequency end of the main tuning dial.

2nd L. P. FILTER - Board #1394

A single section low pass Pi filter cutting off at about 30 kc. removes the high frequency components generated in the 2nd modulator and eliminates their overloading the following sections.

CURRENT GENERATOR - Board #1394

Q509 utilizes the high collector impedance of a transistor to make a current source for the following filter section.

6 kc VARIABLE BAND PASS FILTER - Boards #1395, #1396 and #1397

The variable band pass filter consists of a three section filter. Since the circuit details of the three sections are similar they are treated as a whole.

The filter has four fixed selectable positions. Band widths of 10 and 30 cycles (±5 and ±15 cycles) are obtained by synchronously tuning the three sections and varying the Q of each. The flat topped positions 100 and 1000 cycles (±50 and ±500 cycles) are designed by using Butterworth's approximation. Details as to the design of such a filter can be found in several references. 1, 2, 3.

1. Ernst A. Guilleman, Synthesis of Passive Networks, John Wiley and Sons, New York, 1957, Chapt. 14.

2. Valley and Wallman, Vacuum Tube Amplifiers, McGraw Hill Book Co., New York, 1948, Chapt. 4.

3. Federal Telephone and Radio Corp., Reference Data for Radio Engineers, 3rd Edition, Knickerbocker Printing Corp., New York, Page 127.

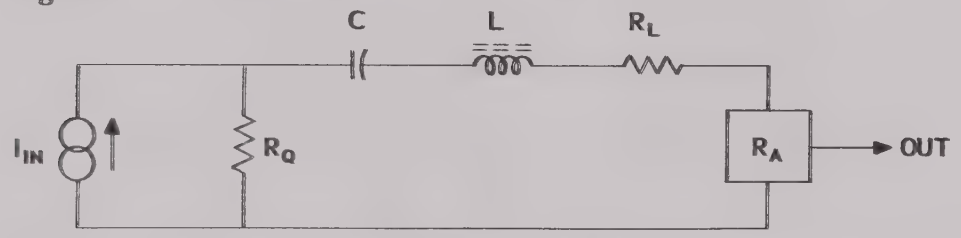


Figure 4. A FUNCTIONAL DIAGRAM OF A FILTER SECTION

R_A is a negative resistance generated by a feedback amplifier. If R_A is adjusted so $R_A = R_L$ at the resonant frequency, then the Q of the circuit is determined by R_Q only. Thus the Q and frequency of a filter section may be adjusted to the desired value by proper selection of its R_Q and C. Since the deviation from the center frequency is quite critical, tuning is accomplished by subtracting and adding capacitance from a carefully tuned center frequency value.

The proper operating frequencies for filter section 1, 2, and 3 are listed below.

Table I
6 kc VARIABLE BAND PASS FILTER OPERATING FREQUENCIES
f_o = 6000 cycles

Δf	f_1	Q_1	f_2	Q_2	f_3	Q_3
10	f_0	295	f_0	295	f_0	295
30	f_0	95	f_0	95	f_0	95
100	f_0	60	$\frac{f_0}{1.0072}$	120	$1.0072f_0$	120
1000	f_0	6	$\frac{f_0}{1.072}$	12	$1.072f_0$	12

In the first filter section (Board #1395) Q601 and Q602 form a feedback pair having both negative and positive feedback. The proper amount of negative input resistance is obtained by adjusting R608. A voltage output is taken from the collector of Q602.

Operation of the second and third sections is similar except the output appears as a current generator.

METER ATTENUATOR

The meter attenuator (MILLIVOLTS FULL SCALE) is a simple ladder type.

AMPLIFIER - Board #1395

Q603 and Q604 form a feedback pair and offer negligible loading on the attenuator. A current output provides the proper drive for the following filter section.

BAND PASS LEVEL ADJUSTMENT - Board #1398

Gain adjustments ganged to the BANDWIDTH switch compensate for differences in the transfer level of the four filter positions.

METERING CIRCUIT - Board #1398

The metering circuit consists of a three stage amplifier having negative feedback through the rectifying diodes CR901 and CR902 thus providing high stability and accuracy. Q903 and Q904 are a single ended, push-pull pair having peak output current capabilities of 15 ma. for proper noise signal metering.

S902 (FAST - SLOW) switch connects C907 into the circuit when a long time constant is required.

MONITORS

A D.C. output for monitoring or recording purposes is connected to the metering circuit and is adjustable to +1 volt at full scale deflection by R917. If excessive loading occurs due to the monitoring equipment correction may be made by adjustment of R226. Remember to re-adjust the instrument after removing the monitoring equipment.

A potentiometer geared to the main tuning dial provides a voltage proportional to the angular position of the dial.

SECTION IV

MAINTENANCE AND CALIBRATION

The components and transistors in the Model 303 are conservatively rated and should provide long and trouble free service. If, however, the instrument has been damaged and recalibration or alignment is required, the following instructions should be followed explicitly, or the instrument returned to the factory. Instructions are given on the Warranty page for the procedure to be followed should it be desired to return the instrument for any reason.

Although the Model 303 is a complex instrument, trouble shooting can readily be done in sections as indicated in the simplified block diagram. Standard transistor servicing care should be used throughout.

DO NOT CHANGE ANY ADJUSTMENTS without a thorough knowledge of the circuit and the function of the adjustment.

Transistors can easily be damaged with large transient voltages. Therefore take great care not to short any terminals when measuring on the printed circuit boards. In soldering to the boards have the iron only hot enough to make a rapid clean solder joint. Do not apply any force which would tend to push the copper away from the board.

A useful driving probe for testing can readily be made from a shielded cable with a 1 megohm resistor at the probe end.

1. REMOVAL FROM CASE

To remove the unit from the case, remove the four feet and two screws from the bottom. This may best be done by tipping the instrument at about 45° to one side and then the other. Slide the unit gently out the front of the case.

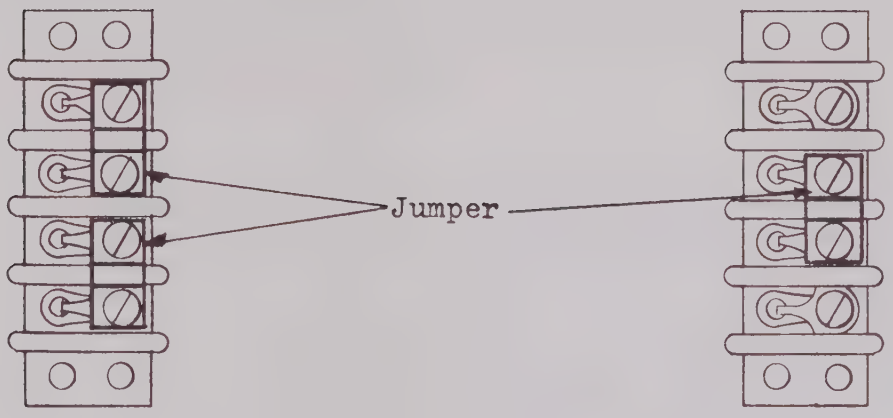
2. CHANGING INPUT VOLTAGE

This instrument has been designed to operate from a 117 V.A.C. or a 234 V.A.C. power source. The plate on the rear of the instrument near the power cord indicates the voltage and frequency at which the instrument should be operated.

Should it be desired to change the input voltage,

1. Remove the two self tapping screws which hold the voltage plate. If there is a small line voltage switch under the plate, simply change it to read the desired voltage and replace the plate with the proper voltage showing.

2. If there is no switch under the voltage plate, the voltage change must be made inside the equipment.
   a. Remove the instrument from the case.
   b. Change the transformer primary connections by moving the jumpers on the four terminal barrier strip located near the power cord (see Fig. 5)
   c. Reverse the plate located near the power cord to read the correct voltage.



For 117 V.A.C. operation

For 234 V.A.C. operation

FIGURE 5. INPUT VOLTAGE BARRIER STRIP

3. Change the fuse. For 117 V.A.C. operation, the fuse should be 1/4 Amp. Slow Blow; for 234 V.A.C. operation the fuse should be 1/8 Amp. Slow Blow.

4. Reverse the plate located near the power cord to read the correct voltage.

3. POWER SUPPLY AND CALIBRATING REFERENCE

Adjust R109 until the output is -25 volts. Plus or minus .5 volt is satisfactory. All purple leads are -25 volts.

Adjust R112 until the reference output at the black and white lead to switch, S202, on rear of GAIN pot (R218) is approximately 9.5 mv. After alignment of the instrument this should be adjusted for full scale on the 100 mv position against a standard input to the instrument. This adjustment should be made at a 115 v rms. line. Deviation of the reference should not exceed ±1% for a ±10% line change.

4. METER AMPLIFIER

Insert a signal at the INPUT of the instrument or a 6 kc signal of approximately .014 v rms at the input of board 1398 (green lead). Adjust to give full scale deflection on the 1.0 scale. Adjust R917 to give exactly 1.0 v output at the monitor terminal No. 1 of J301.

5. 6 kc VARIABLE FILTER

Usually the 6 kc variable filter may be aligned by merely peaking from a signal at the input of the instrument, however, it may also be done by inserting a 6 kc signal through a high impedance (1 meg. ohm) to the input of Board #1395 (Blue lead). Be sure to use a blocking condenser since this point is at B-.

Set the BANDWIDTH control at 10 cycles. Peak carefully for maximum meter output by tuning C603, C702 and C802 on boards #1395, #1396 and #1397. If R_Q is shorted, the tank circuits may be adjusted for infinite Q. To do this, use a short clip lead and on board #1397 short the two pins at the top of the board and with 6 kc input signal removed adjust R809 until the meter just begins to read (i.e. the circuit is just beginning to oscillate). BE CAREFUL not to short out or ground any other parts of the circuit nor to ground the pins.

Repeat above for board #1396 and R710.

Turn MILLIVOLTS FULL SCALE control to 1 or 3 and repeat above for board #1395 and R608.

Retune all three sections to 6 kc (± .25%) again. Note this tuning is critical and drift of the 6 kc oscillator used for driving should be eliminated by a good warm-up, and must be held to within one cycle during the peaking.

If the above procedures have been properly carried out the -3 db bandwidth points should be as listed to within ± 5%.

With a driving current of approximately 3-1/2 μ a rms into the input to board #1395 the meter should read full scale with the MILLIVOLTS FULL SCALE (S602) at 10. Adjust in the following order R909, R908, R907, and R906 on board #1398 until the meter readings are the same for BANDWIDTH positions 1000, 100, 30, and 10 respectively.

6. LOW PASS FILTER #2 AND CURRENT GENERATOR

The second L.P. filter and Q509 on board #1394 may be checked by driving the test point at the filter input (bottom right corner) with a high impedance. Approximately half scale meter deflection should be obtained on MILLIVOLTS 10 position with a 0.25 μ a 6 kc signal.

7. FIXED FREQUENCY OSCILLATOR AND 2ND MODULATOR

A test at the bases of Q505 and Q506 should show a positive half wave of 1 volt peak and at approximately 142 kc. The second modulator can be readily tested by driving a signal into the base of Q502 at a frequency 6 kc above the fixed oscillator (148 kc). Approximately .05 v rms will give full scale deflection on MILLIVOLTS FULL SCALE 300 position.

8. 148 kc FILTER

Alignment of the 148 kc bandpass filter can be quite tedious without a proper sweep oscillator and oscilloscope. There is no simple procedure for tuning this filter. The filter has been carefully adjusted at the factory and re-alignment should not be necessary. If re-alignment is necessary, monitor the filter output at the emitter of Q502 and drive it with a high impedance (1 meg) at the collectors of Q303 and Q304. Capacitance loading should be avoided at both terminations. Never make an adjustment of the trimmer capacitors in the filter until all other parts of the instrument are in proper operating condition, and then ONLY make SMALL adjustments. An alternate method of sweep drive is to use the monitor output #3 of J301 as the horizontal sweep for an oscilloscope and the emitter of Q501 for the vertical sweep. Drive the input of the instrument with a signal at about 5 kc and sweep the main tuning dial through the filter pass band.

In practice the filter will center at about 148 kc and should have a flat top to within ± 1% over a 2 kc spread. Approximately 8 db insertion loss is to be expected. In tuning the filter be careful not to broaden the skirts. It is helpful to kill the fixed oscillator by shunting the tank circuit to ground with a .5 mfd capacitor at C509 when making the alignment.

9. RE-ALIGNMENT OF FIXED OSCILLATOR

After the 148 kc bandpass filter is in proper adjustment the fixed frequency oscillator should be re-aligned to be 6 kc below the center of the filter. If this is not done, asymmetry of the 1000 cycle bandpass position will result. Be sure to have the VERNIER at 0 and the ZERO BEAT adjustment near the center of its range.

10. VARIABLE OSCILLATOR AND 1st MODULATOR

In aligning the variable oscillator to track with the main tuning dial, first make sure the dial has not slipped on the shaft. To check this, the following procedure should be used:

1. Turn the dial until the stop is on the right or top and remove. Rotate the dial to the mark just beyond the 100 kc position. The condenser plates should be fully meshed. This may be checked exactly by turning the instrument off and using a flat plate, such as the end of a machinists rule, bear against the stator plates and rotate the dial until the rotor plates are felt. Re-align dial on shalt if necessary.

2. Turn the instrument on and with the fixed oscillator in its re-aligned condition set the main dial to 0. Adjust C309 to give zero beat.

3. Insert a 100 kc signal into the INPUT terminals and tune the main tuning dial. If the range of the dial is too large, decrease C309 and increase L301.

4. Repeat steps 2 and 3 until proper end point alignment is achieved.

The tracking adjustments of the main tuning capacitor are for dial tracking below 5 kc and should not require further adjustment after factory alignment.

The modulator balance resistor R320 should be adjusted to give a minimum zero beat signal when R324 is at the center of its range.

A 1 μ a signal at dial frequency, inserted at input to board #1393 (shielded lead), will give a reading of approximately 7 mv.

11. INPUT ATTENUATOR AND PRE-AMP

Adjustment of the input attenuator and pre-amp sections is as follows:

1. With METER MULTIPLIER at X.1 and MILLIVOLTS FULL SCALE at 300, apply a .03 volts rms 1 kc signal at the X1 INPUT terminal and note meter reading.

2. Increase signal to .3v and apply to X10 INPUT terminal. Adjust meter to noted value with R216. The input impedance is now 100 k ohms at the X1 terminal.

3. Adjust R226 at rear of instrument until meter reads 3.

4. Increase generator frequency to 100 kc. Adjust C202 to meter reading of 3.

5. Increase input signal to 3 v rms, set METER MULTIPLIER to X1 range and adjust C203 to a meter reading of 3.

6. Tune instrument to line frequency, turn GAIN control fully counter-clockwise to 0.1 v 60 cycle position. Set MILLIVOLTS FULL SCALE control to 100 and adjust R112 of calibrating reference until meter reads 1.0 (full scale).

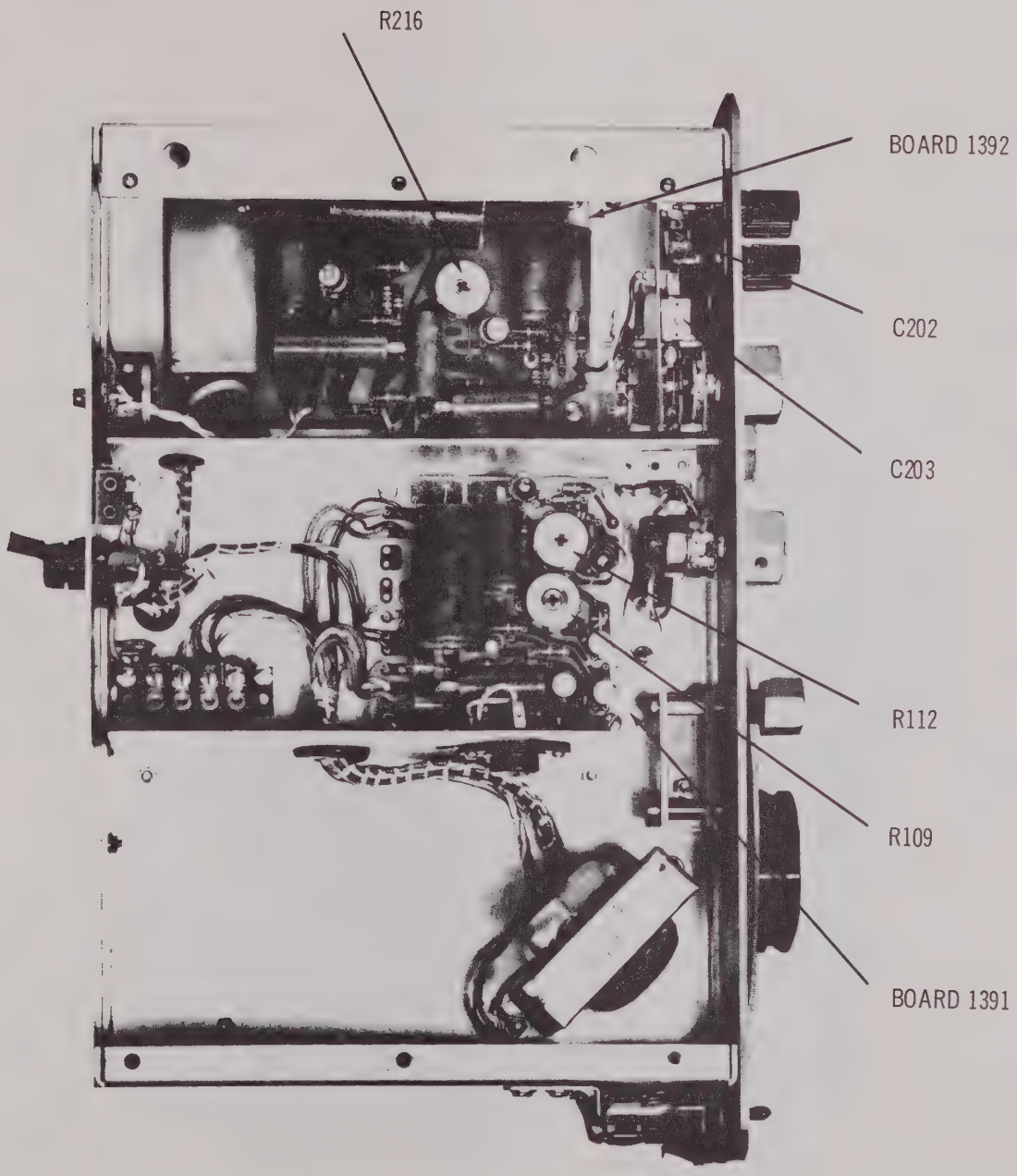


Figure 6

ADJUSTMENT POINTS

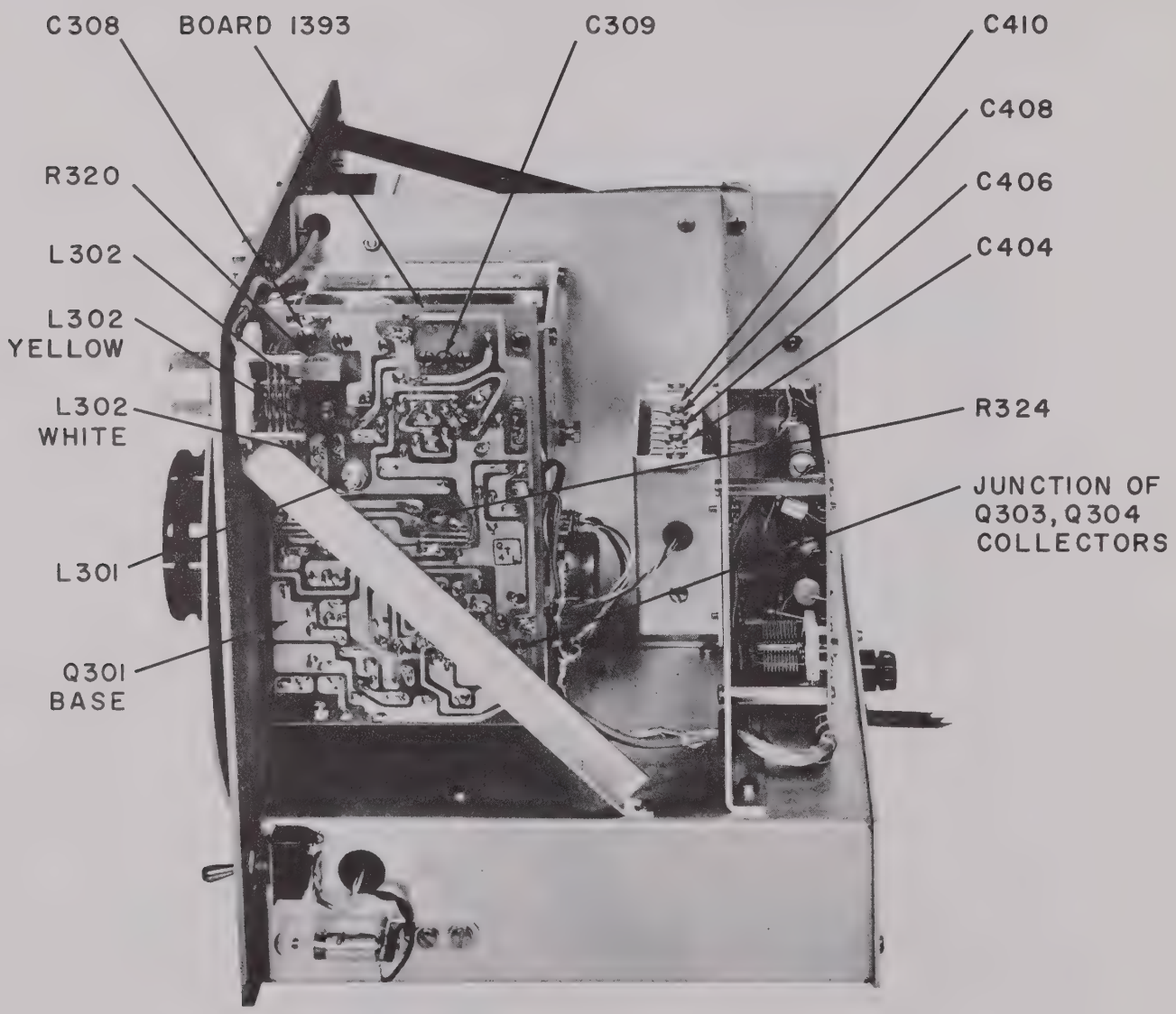


Figure 7

ADJUSTMENT POINTS

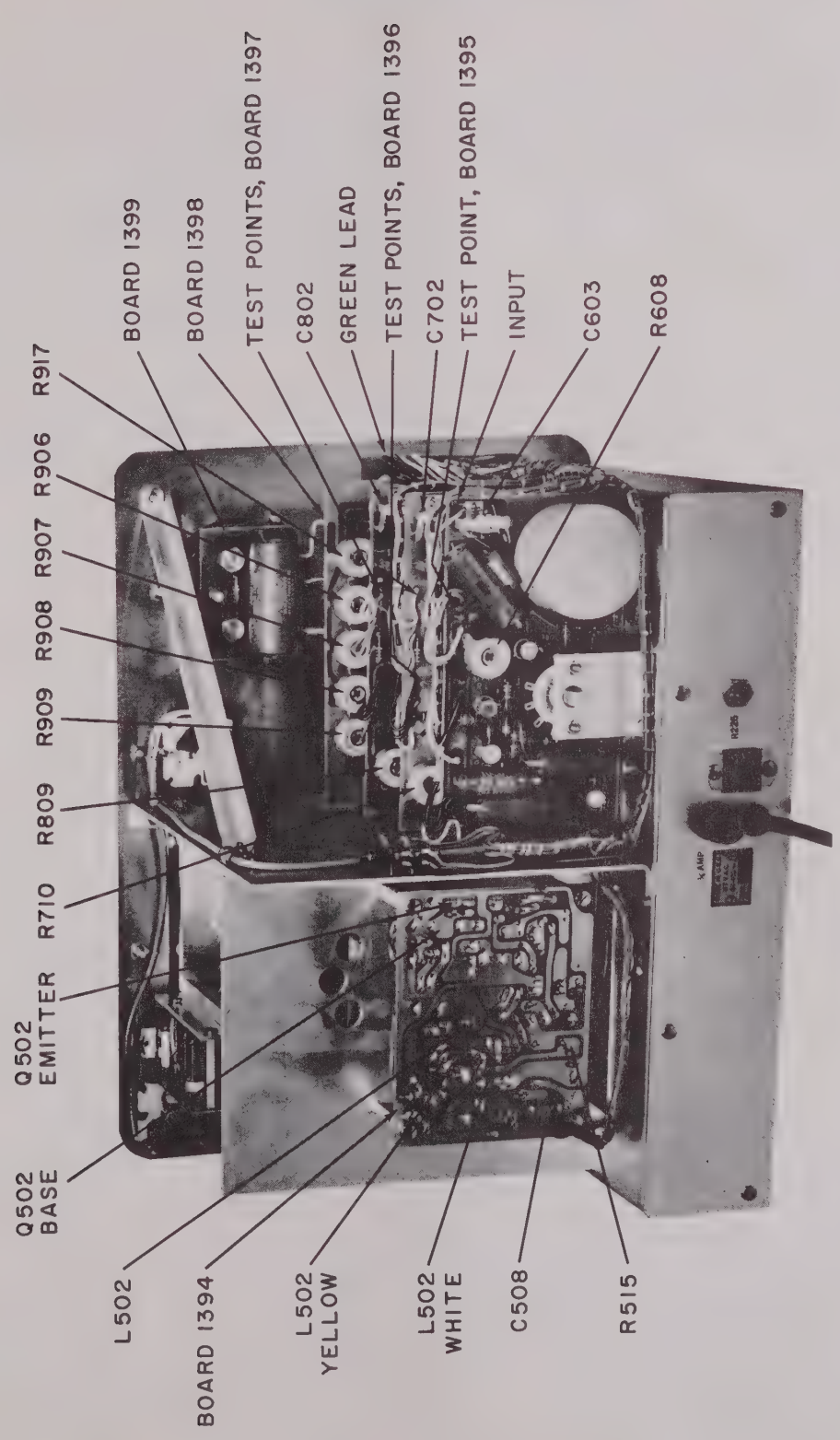


Figure 8
ADJUSTMENT POINTS

SCHEMATIC LEGEND

K = 1000

⊘ = Screw Driver Adjustment

▭ = Front Panel Control

* = Factory Select

Unless Otherwise Specified:

All Resistances in Ohms

All Resistors 1/2 Watt

All Capacitances in Microfarads

SEMICONDUCTOR LEGEND

Changes and improvements in the semiconductor products available for commercial use necessitate type changes from time to time. To eliminate confusion and costly paperwork, many of these changes will be covered in the following legend. The purpose of this legend is to acknowledge the fact that the type number on a semiconductor found in a piece of equipment will not necessarily correspond with the type number given on the schematic diagram.

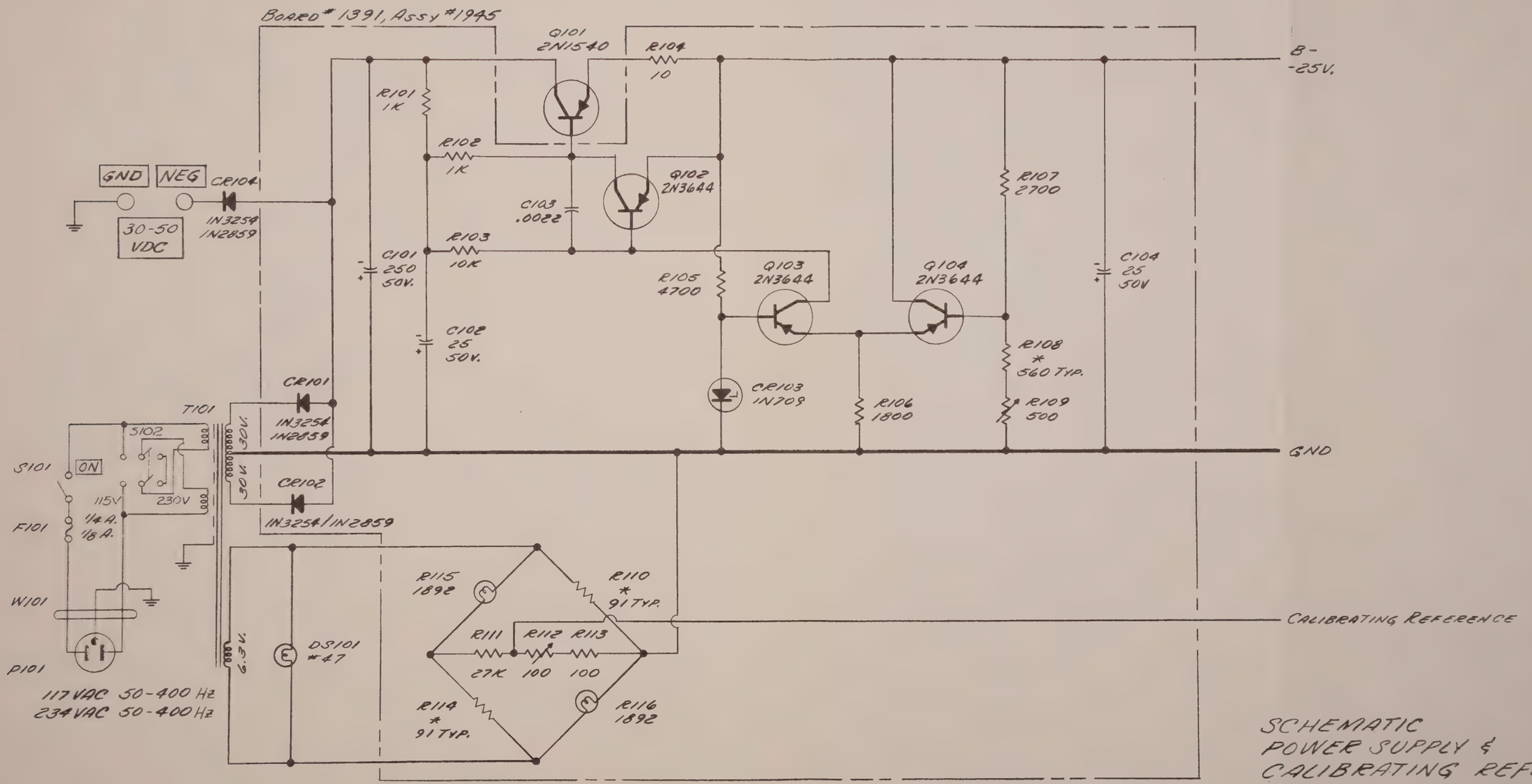
The legend is not intended to be an interchangeability list although in many cases good quality components* within a given category may be substituted with acceptable results. Normally, replacements should be made using components having the same type number as the component being replaced.

Those components bearing an asterisk on the schematic diagram are factory selected components and should be obtained from Quan-Tech Laboratories.

*It should be noted that the incoming inspection procedure followed at Quan-Tech Laboratories includes noise screening on most semiconductors.

TYPE # ON SCHEMATIC	TYPE # IN EQUIPMENT
T1480	2N1613
T1494	2N1613
1N703	1N748
1N709	1N753
1N2859	1N3253, 1N3254
1N2862	1N3254
1N482A	1N3604
1N3253	75A4
1N3254	75A4
2N396A	4JX1G759, 4JX1D653, 2N3644
2N414	2N396A, 4JX1G759, 4JX1D653, 2N3644
2N929	2N0N2, A642, 2N3566, A322, A324
2N1515	2N3644
2N1613	2N3566
2N2219	220N2, A642, 2N3566, A322, A324
2N2603	2N3250
2N3250	2N3644
2N270	2N3644
2N1306	2N3566
2N1304	2N3566
2N3250	2N3251
UC240	2N4869
2N3644	2N3250, 2N3251

1/18/68



SCHEMATIC
POWER SUPPLY &
CALIBRATING REFERENCE
MODEL 303

T-1381-M

INPUT ATTENUATOR | PRE-AMPL. | VARIABLE ATTEN. | AMPLIFIER & METER CAL. | L.P. FILTER

BOARD #1392-1, ASSY #1946

B−

R201 150

C201 500 25V.

R210 22K

R211 4700

R212 1800

C206 500 15V.

R221 33K

R222 4700

R223 820

C210 500 15V.

CR201 IN816 IN482A

METER MULTIPLIER S201

INPUT

X10 R202 910K/1W/±1% X1 C215 .5 600V.

X.1 R203, 4.7 MEG R204 91K 1W ±1%

R205 10K ±1%

R206 910 ±1%

R207 91 ±1%

R208 10 ±1%

C202 1-7 pf.

1 MEG 100K

X1

X10

X100

X1K

C203 3-35 pf

R209 4700 C204 10 50V.

CR202 IN816 IN482A

R215 120K

Q201 2N3250

R214 33K

R216 500

C205 25 50V.

R213 18K

R217 4700

C207 10 50V.

GAIN

R218 10K

C208 25 50V.

3202

R219 1K

TO CALIBRATING REFERENCE

Q202 2N1306

Q204 2N1306

Q203 2N414

R220 2200

R224 22K

R225 1800

C209 100 25V.

R229 270

R226 1K

R227 1K

R228 * 4700 TYP.

L201 8.2MH

L202 8.2MH

L203 8.2MH

C211 330 pf.

C212 680 pf.

C214 250 pf.

C213 680 pf.

TO PHASE INVERTER

BOARD #1392-2, ASSY #1947

SCHEMATIC
PRE-AMPLIFIER
MODEL 303

T-1382-L

PHASE INVERTER | BALANCED MODULATOR | VARIABLE OSCILLATOR

B-

BOARD #1393, ASSY #1948

R301 560

C301 100 25V.

R303 15K

R305 2200 ±1%

R307 2200

R310 4700

R315 39K

R326 1K

TO FILTER

R316 10K

R317 10K

R311 1K

C306 .01

Q303 2N414

Q304 2N414

C304 10 25V.

R313 5600 ±1%

R314 5600 ±1%

R322 470

R323 47

R329 10K

L302

R324 100

R325 470

L301 120-240 UH 60-120 UH

R331 1200

R334 33K

C312 .5 200V.

Q307 2N1515

Q308 2N1515

C311 .05 200V.

TO PRE-AMP.

C303 10 25V.

Q301 2N414

Q302 2N414

R308 2200 ±1%

C305 10 50V.

R318 * 47 TYP.

R320 100

R319 2200 ±1%

R321 2200 ±1%

C313 27pf.

C309 3.2-50 pf.

R327 2200

Q305 * 2N711

Q306 * 2N711

R338 2200 ±1%

R337 2200 ±1%

C310

R328 10K

R330 1K

R332 560

R333 560

R335 2200

R304 6800

R306 2200 ±1%

R309 2200

R312 2700

C307 250pf.

C308 180-780pf.

CYCLES

FREQUENCY ANALOG

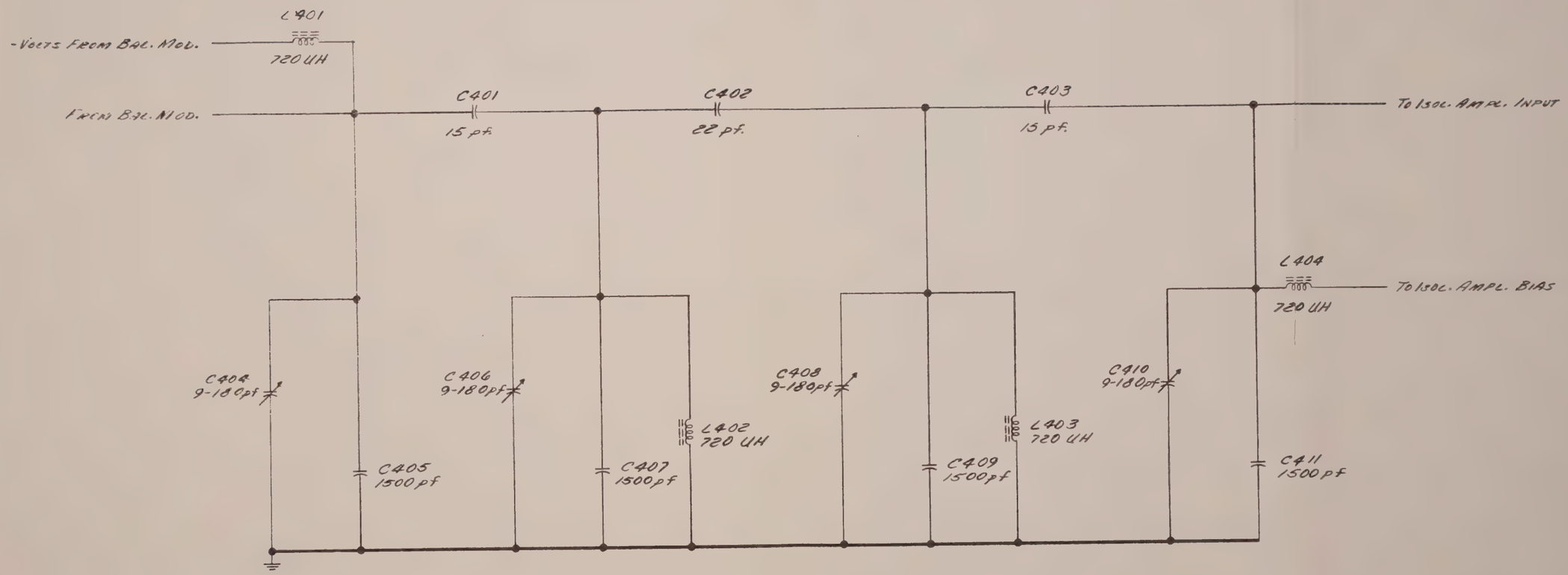
P301

J301

SCHEMATIC
BALANCED MODULATOR &
VARIABLE OSCILLATOR
MODEL 303

T-1383-M

BAND-PASS FILTER- 148Kc.



SCHEMATIC
BAND-PASS FILTER -148 Kc.
MODEL 303

T-1384-C

B- ISOL. AMPL. | PHASE INVERT. | BALANCED MODULATOR | LOW PASS FILTER | CURR. GEN. | FIXED OSCILLATOR

BOARD #1394, ASSY #1949

R501 560
C501 25 50V.
R502 22K
R505 10K
R507 2200
R510 22K
C505 .0022
C513 .0022
R514 2200
R521 1000
L501 8.2MH
Q503 2N414
Q504 2N414
Q509 2N414
To 1ST SECT. L.K.C VAR. BAND FILTER
FROM 148 Kc FILTER
R503 82K
C503 .0047
Q501 2N1632
Q502 2N414
R511 5600
R512 5600
R519 * 220 TYP.
FROM 188 Kc FILTER
R508 2200
C504 .0047
R517 470
R518 470
C502
R522 10K
R515 1500
R516 1500
Q505 2N1632
Q506 2N1632
R504 10K
R506 10K
R509 2200
R513 10K
C502 .25 200
C506 25 50V.
R520 4700
VERNIER
C507 2.8-11 pf.
ZERO BEAT
C509 3.5-27 pf.
C510 560 pf.
C514 22 pf.
C508 3.2-50 pf.
Q507 2N1515
Q508 2N1515
R524 1200
C511 .05 200V.
R527 33K
C512 .25 200V.
R523 1000
R525 560
R526 560
R528 2200

SCHEMATIC
BALANCED MODULATOR &
FIXED OSCILLATOR
MODEL 303

T-1385-H

1ST SECTION VARIABLE BAND-PASS FILTER -6 Kc | METER ATTEN. | AMPLIFIER

B-

BOARD #1395, ASSY #1950

BOARD #1399, ASSY #1941

FROM CURR. GEN.

C601 100 25V.

R602 22

R603 68

R604 110

R605 1100

R606 390

R607 330

10 | 30 | 100 | 1000

S601A BANDWIDTH

C602 .0039

C603 9-180 pf

L601 175 MH

R608 1000

R609 * 1500 TYP.

R610 22K

Q601 2N1304

C604 100 pf

C606 10 50V.

Q602 2N3644

R611 5600

R612 4700

R613 1200

C605 50 6V.

R624 100K

R627 120

R614 10 ±1% 300

R615 20 ±1%

R616 63.3 ±1%

R617 200 ±1%

R618 633 ±1%

R619 2000 ±1%

100 | 30 | 10 | 3 | 1

S602 MILLIVOLTS FULL SCALE

R620 2200

C607 .0047

R621 47

R622 10K

R623 2200

C608 50 6V.

Q603 2N1304

Q604 2N3644

C609 50 6V.

R625 10K

R626 4700

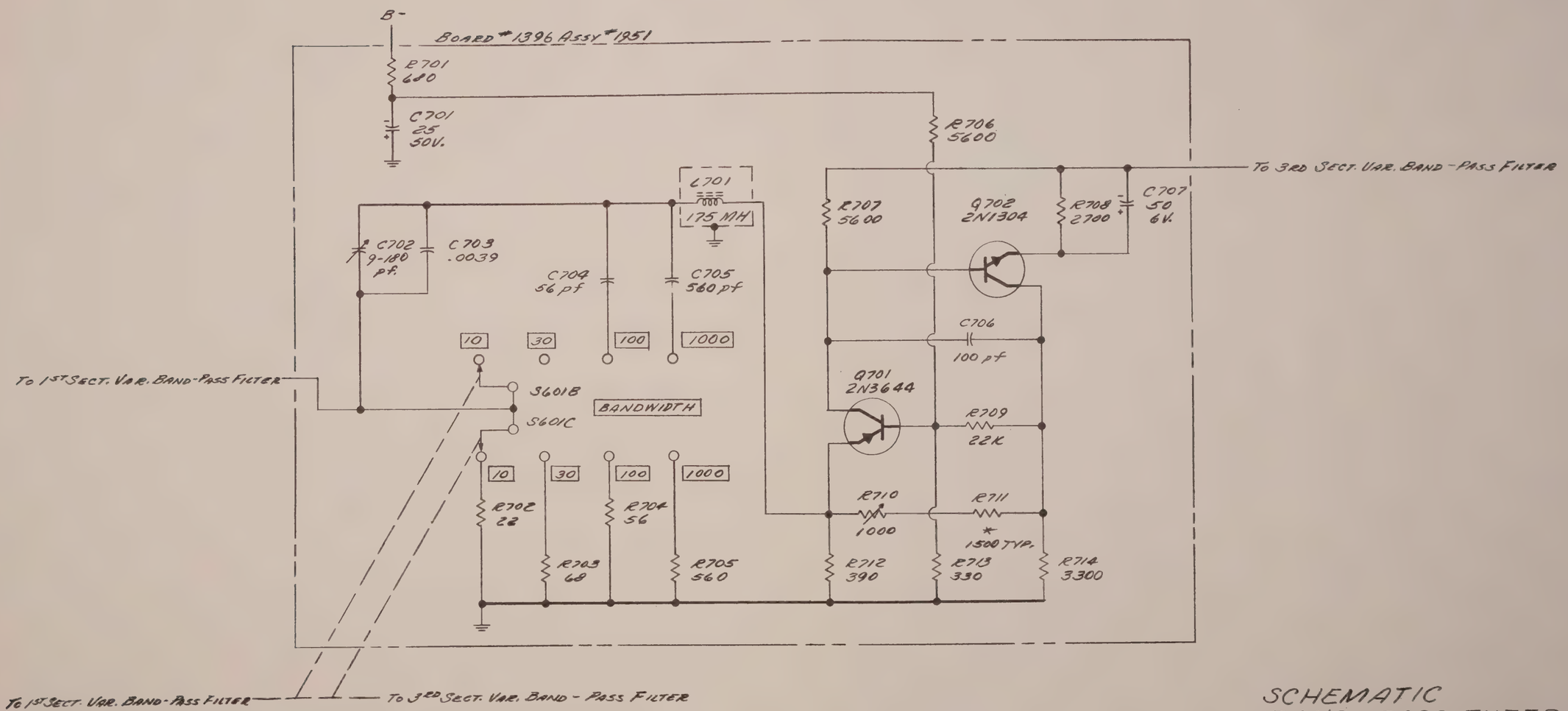
TO 2ND SECT. 6 Kc VAR. BAND. FILTER

TO 2ND SECT. VAR. BAND. FILTER

SCHEMATIC
BAND-PASS FILTER -6Kc
MODEL 303

T-1386-H

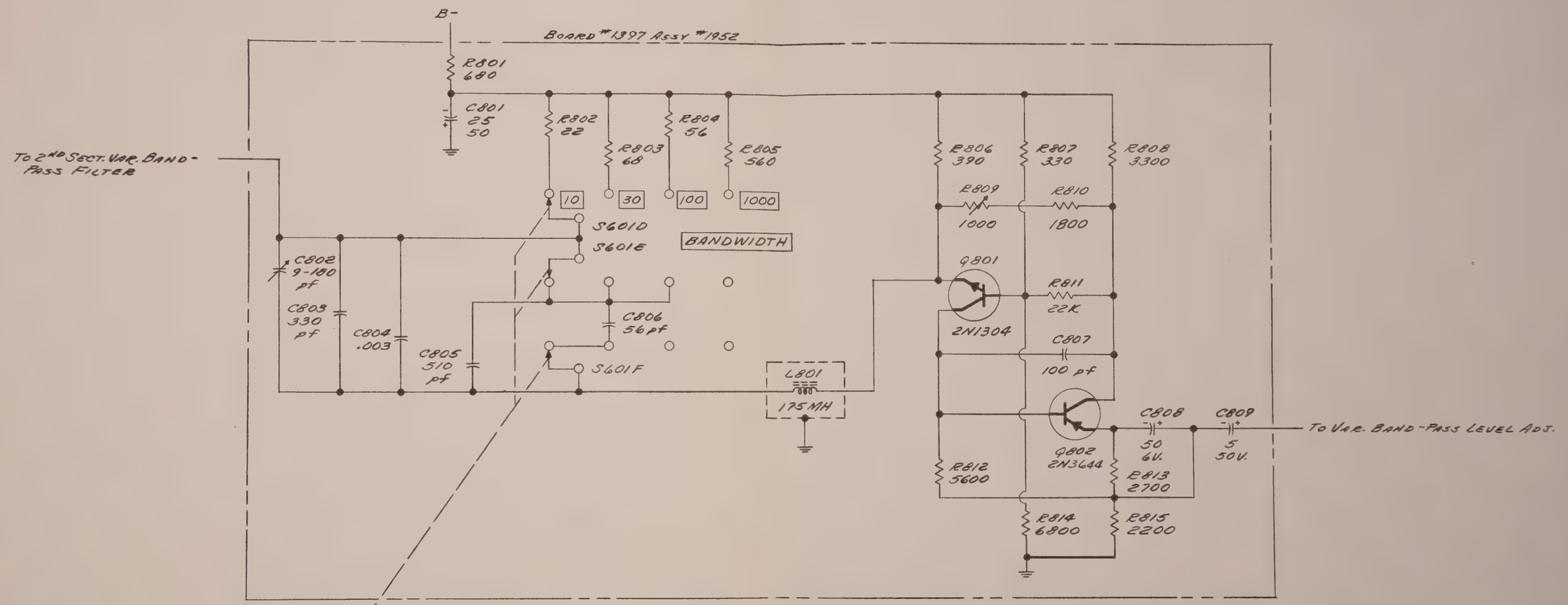
2ND SECT. VAR. BAND-PASS FILTER - 6KC



SCHEMATIC
BAND-PASS FILTER-6Kc
MODEL 303

T-1387-F

3RD SECT. VAR. BAND-PASS FILTER - 6 Kc

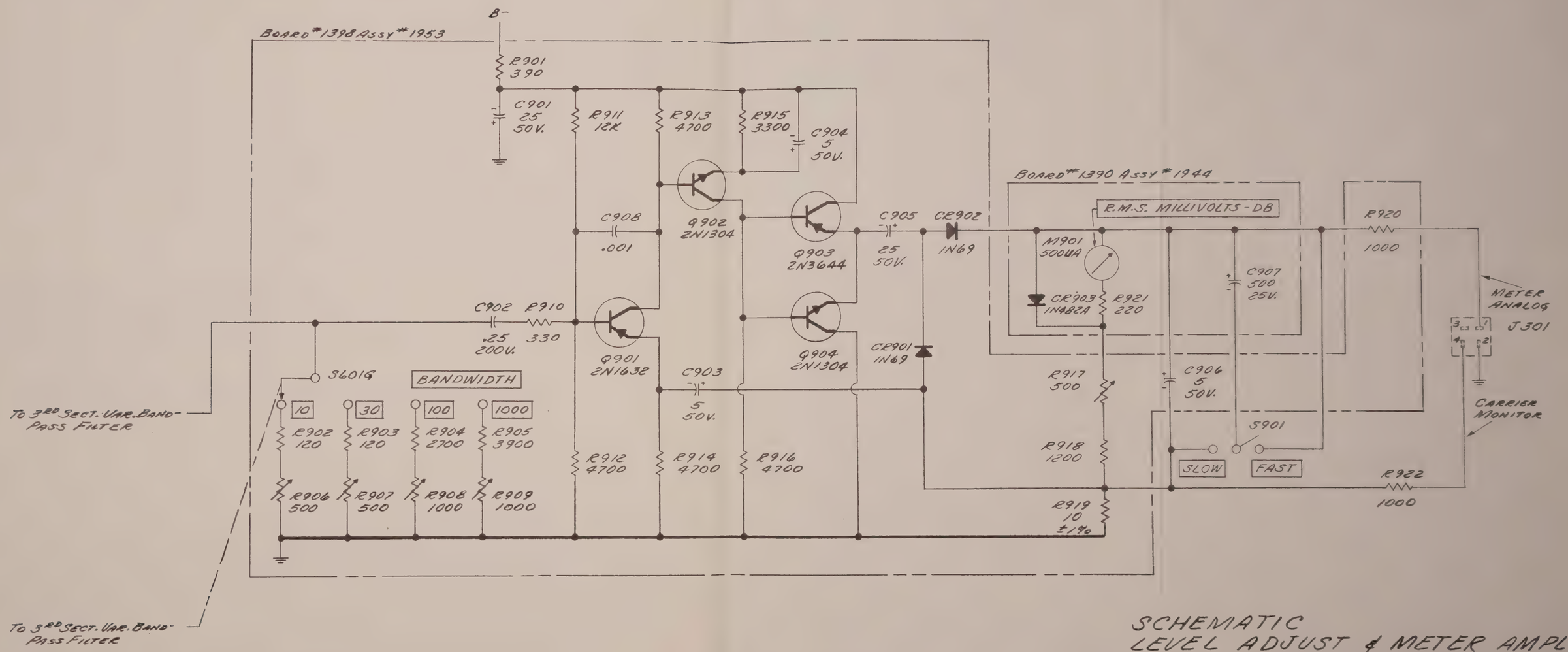


SCHEMATIC
BAND-PASS FILTER - 6 Kc
MODEL 303

T-1388-G

VAR. BAND - PASS LEVEL ADJ.

METER CIRCUIT



SCHEMATIC
LEVEL ADJUST & METER AMPL.
MODEL 303

T-1389-K

Quan-Tech LABORATORIES, INC.

INSTRUMENTS • AMPLIFIERS • NOISE INSTRUMENTATION

SHORT FORM CATALOG

A Word About Noise Analysis

Since 1957 when it was founded, Quan-Tech Laboratories has specialized in the amplification and measurement of extremely low level signals approaching the theoretical limits of sensitivity. In order to build equipment of this sort it was necessary to select components having the lowest possible electrical noise for use in the most sensitive parts of the circuit. Noisier components were relegated to places where (it was thought) their noise would not interfere with proper operation. These noisy components exhibited a very high rate of failure compared to the quiet ones, so an intensive study of the reasons for these failures was undertaken.

Investigation showed that those components which exhibited excessive amounts of noise (particularly of the "1/f" type) compared to similar units, usually contained some defect or abnormality which could lead to early failure. This was equally true of resistors, transistors, and diodes, even though the failure mechanism might be different for each device.

This discovery led to the development of specific electrical noise measuring instruments for each type of component. Cooperative programs with manufacturers have proved beyond doubt that noise measurements, properly applied, can locate many types of failure-prone components before they are placed in the circuit, with resultant cost saving and increased reliability. Even manufacturers of such fiercely competitive items as automobile radios, electronic organs, and hearing aids have found noise screening cuts costs and improves product quality.

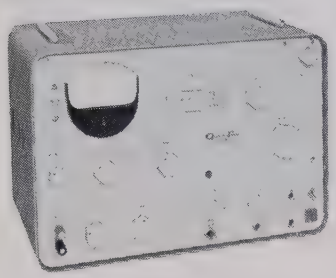
If you haven't already investigated the benefits of noise analysis, both for reliability and for very low noise applications, why not contact us or our local representative and get the full story?

Quan-Tech LABORATORIES, INC.

Quan-Tech LABORATORIES, INC.

WAVE AND SPECTRUM ANALYZERS

ACCURATE • VERSATILE • RELIABLE • PORTABLE • FIVE INSTRUMENTS
1 Hz to 200 KHz • ALL SOLID STATE



Model 304

LOW FREQUENCY WAVE & SPECTRUM ANALYZER

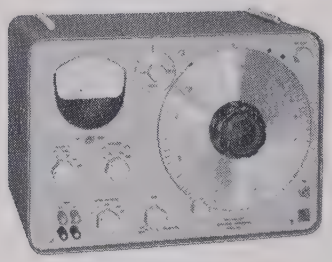
Frequency range: 1 Hz to 5 KHz; **Bandpasses:** 1, 10 & 100 Hz, selectable at front panel; **skirt selectivity:** 24 db per ½ bandwidth; **Voltage range:** 30 μV to 100 V, FS; down to .03 μV, FS, with accessory Model 206B preamplifier (see last page); **Tuning:** Manual or automatic; Internally supplied electronic sweep of total frequency range or of discrete portions; provision for external sweep; **Frequency calibration:** Linear 1 Hz per division; **Outputs:** BFO, restored signal, sample of automatic sweep, analogs of meter reading and frequency setting, phase output for phase plot on X-Y recorder. **Price:** $2450.

OPTIONAL FEATURES

Pen lift; AFC; Log, squared, or RMS meter reading; slave operation for multi-channel analyzer system. **Prices:** Upon request

WAVE AND SPECTRUM ANALYZER **Model 305**

Similar to Model 304 except: **Frequency Range:** 10 Hz to 50 KHz. **Bandpasses:** 10, 100, and 1000 Hz and broadband, 10 Hz to 65 KHz. Also includes AFC, tracking filter operation, and built-in master-slave capability for multi-channel analyzer systems. **Price:** Upon request



Model 303

WAVE AND SPECTRUM ANALYZER

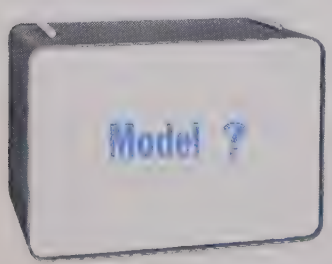
Frequency range: 30 Hz to 100 KHz. **Bandpasses:** 10, 30, 100, 1000 Hz, selectable at front panel. (100 and 1000 Hz bandwidths flat-topped for simplified noise computation, greater accuracy and convenient tuning. **Sensitivity:** 100 μV to 300 V, FS. Down to 1 μV FS with accessory Model 203 preamplifier (see last page). ± 300 Hz vernier; selection of long or short meter time constants; metering circuits compensated to minimize error from instantaneous noise pulses; overload-protected meter; analog output for external monitoring. **Price:** $1550.

WAVE AND SPECTRUM ANALYZER **Model 2156**

Similar to above except: **Frequency range:** 10 Hz to 30 KHz. **Bandpasses:** 3, 10, 30, 300 Hz. **Price:** $2150.

WAVE AND SPECTRUM ANALYZER **Model 2223**

Similar to above except: **Frequency range:** 10 Hz to 200 KHz. **Bandpasses:** 10, 100, 750, 1000 Hz. **Price:** Upon request.



Have we left you out?

While the analyzers listed above cover the great majority of applications, special requirements can often be met by a modification or minor redesign of an existing instrument. Let us know your problem and we'll see if we can't help solve it.

All prices shown are F.O.B. Whippany, N. J. Prices and specifications subject to change without notice.

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Quan-Tech LABORATORIES, INC.

TRANSISTOR NOISE ANALYZERS

R.F. TRANSISTOR NOISE ANALYZER

Measures noise figure directly of transistors and FET's at radio frequencies. Plug-in heads available for test frequencies between 1 MHz and 60 MHz. **Noise figure range:** 0 to 40 db. **Base resistance range:** 50, 100, 200, 500, 1K, 2K, 5K ohms. **Collector voltage range:** ±1 to 30 volts. **Collector current range:** 30 μa to 30 ma. **Price:** $2200.

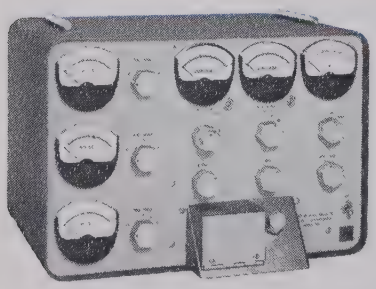
Heads available from $1250 up.

Model 340

TRANSISTOR NOISE ANALYZER

The most versatile unit available. Measures noise current and voltage at 10 and 100 Hz, 1, 10, and 100 KHz simultaneously. **Noise spectral density range:** 3 to 3000 nanovolts FS. **Base resistance range:** 0, 500, 1K, 10K, 100K, and 1M ohms plus external position. **Collector voltage range:** 0.3 to 60 volts. **Collector current range:** 0.3 μa to 30 ma. Also measures FET's. **Price:** $4995.

Model 2173C
-2181



Model 310 TRANSISTOR NOISE ANALYZER

Measures noise current and voltage at 100 Hz, 1 KHz and 10 KHz as well as 1_{cbo}, 1_{ebo} and beta. **Noise spectral density range:** 0.01 to 3 μV, FS. 1 to 300 pa, FS. **Collector current range:** 0.05 to 30 ma. **Collector voltage range:** 0.1 to 30 V. **Base resistance range:** 0, 500, 1K, 10K plus external position. **Price:** $2475.

Model 311 TRANSISTOR NOISE ANALYZER

Similar to above, except that collector current range is from 5 to 1000 μa for noise measurement in low-collector-current devices. Measures Gm instead of beta. Also measures FET's. **Price:** $2675.

Model 512 TRANSISTOR NOISE TEST SET

Measures broadband noise figure directly in db. **Noise bandwidth:** 15.7 KHz (—3 db at 10 Hz and 10 KHz). **Noise figure range:** 0 to 62 db. **Collector voltage range;** ±3 to 30 volts. **Collector current range:** 10 μa to 1 ma. **Base resistance range:** 50, 500, 1K, 10K ohms plus external position. Also measures FET's **Price:** $1250.

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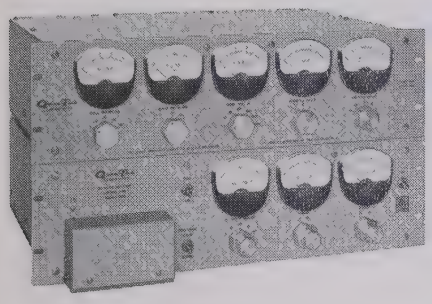
Quan-Tech LABORATORIES, INC.

- **INTEGRATED CIRCUIT NOISE ANALYZERS**
- **RESISTOR & DIODE NOISE ANALYZERS**
- **SPECIAL INSTRUMENTS & SYSTEMS**



Model 2283

Model 2181

INTEGRATED CIRCUIT NOISE ANALYZER

This extremely versatile noise measuring system was designed primarily for measuring noise in linear IC's and Op Amps. Simple plug-in PC cards enable it also to measure discrete components such as resistors, zener diodes, bipolar and FET's. Bias voltages: + and −12V fixed, + and −0 to 30V independently variable at 100 ma. Noise spectral density: 3 to 3000 nanovolts. Filter frequencies: 10 and 100 Hz, 1, 10, and 100 KHz measured simultaneously.

Price: Model 2283 Control Unit $1450.
Model 2181 Filter Unit $2500.

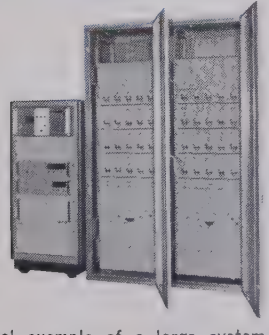
INTEGRATED CIRCUIT TEST SYSTEMS

On special order Quan-Tech can supply systems for measuring not only noise in IC's, but many other AC and DC parameters as well, such as DC offset voltage and current, differential DC offsets, open loop gain, etc. Readings are automatically sequenced, digitized, and stored, with optical readout and provision for printed or punch-card data storage.

Special Instruments

Quan-Tech manufactures a great many "specials", ranging from one unit only to production quantities on an OEM basis. Our engineering department is extremely flexible and equipped to handle anything from minor modifications of standard instruments to the design and construction of an extremely complicated fully automatic noise measuring system. We are proud of our ability to meet difficult specifications that challenge the state of the art for low noise, stability, and accuracy. Your inquiry will receive a prompt reply.

Special Systems



A typical example of a large system designed exclusively for an individual customer's requirements is the **Model 5002,** built for Western Electric. The system has forty channels for detecting insulation breakdown or corona discharge in up to forty reels of transoceanic telephone cable during extended voltage breakdown tests. If any cable emits a noise pulse exceeding a preset level, a digital printer automatically prints out the cable number, test condition, time, and date.

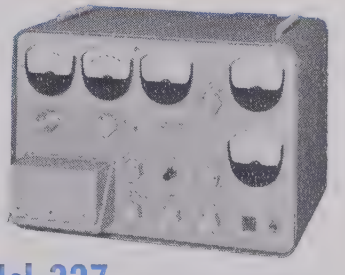
Model 315

RESISTOR NOISE TEST SET

Measures noise in resistors in conformance with specifications recommended by NBS and Method 308 of MIL STD 202B. **Test-resistor range:** 100Ω to 22 meg Ω. **Measurement range:** 0.6 μV in a decade to 1000 μV in a decade. **Outputs:** Sample of noise voltage; analogs of meter readings. External cable supplied for remote location of test jig. **Price:** $2150

MODEL 2136

Similar to above, but measures resistors down to 10 Ω. **Price:** $2300.



Model 327

DIODE NOISE ANALYZER

Measures noise in back-biased semi-conductor diodes at 10 Hz and 1 KHz simultaneously. **Noise spectral density range:** 0.03 μV to 1 mV. **Test Voltage:** 0 to 500 V, continuously variable. **Test current:** 0 to 100 ma, continuously variable. Internally supplied ramp automatically sweeps test current and/or voltage within maximum ratings. A wide variety of outputs for data logging, external monitoring, actuating external equipment, etc. **Price:** $2750.

TYPE 1115 JIG AND TRANSFORMER

For measuring noise in forward-biased diodes up to 100 ma. **Price:** $300.

All prices shown are F.O.B. Whippany, N. J. Prices and specifications subject to change without notice.

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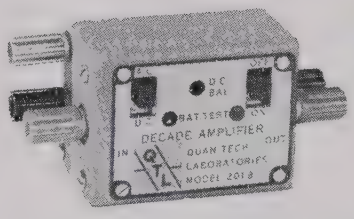
Quan-Tech LABORATORIES, INC.

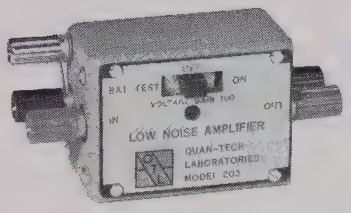
- **SOLID STATE AMPLIFIERS**
- **AMPLITUDE DISTRIBUTION ANALYZER**
- **RANDOM NOISE GENERATOR**



Model 201B

DC DECADE AMPLIFIER AC OR DC COUPLED

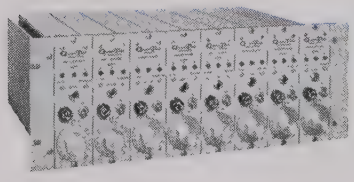
Bandwidth: DC or 10 Hz to 3 MHz (3 db); **Gain:** 10 (fixed); Power: Self-contained batteries; 600 hour life. **Price:** $110.



Model 203

LOW NOISE AC AMPLIFIER

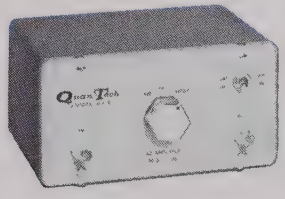
Bandwidth: 30 Hz to 100 KHz (± 0.5 db); —3 db at 500 KHz; **Gain:** 100 (fixed); **Typical noise spectral density:** 5 x 10^{-9} V and 3 x 10^{-12} A at 1 KHz. Battery powered. **Price:** $125.



Model 2220

INSTRUMENTATION AMPLIFIER

Modular amplifiers mount 8 units in a 7″ rack panel. **Voltage gain:** 0 to 80 db in 5 db steps. **Controlled frequency characteristics:** (selected by plug-in cards) voltage gain flat 10 Hz to 100 KHz or 10 Hz to 20 KHz, rising 3 db/octave 10 Hz to 100 KHz or 6 db/octave 10 Hz to 20 KHz. **Price:** $590.



Model 206B

SELECTABLE GAIN AC AMPLIFIER

Bandwidth: 1 Hz to 100 KHz (within 0.5 db); —3 db at 500 KHz. **Typical noise spectral density:** 5 x 10^{-9} V and 3 x 10^{-12} A at 1 KHz. **Gain:** 10, 100, & 1000, selectable at front panel; **Power:** 105-125 V AC or optional self-contained battery pack (automatically recharging). **Price:** $175. Batteries $25.

Model 317

AMPLITUDE DISTRIBUTION ANALYZER

Determines amplitude-probability distribution of random signals. **Amplifier response:** 3 db down at approx. 12 Hz and 1 MHz; **Switching rate:** 5 MHz. **Amplitude ranges:** 100%, 10%, 1% FS; Normal or "inverted" operation; provision for external sweep of level. **Price:** $450.

Model 420

RANDOM NOISE GENERATOR

Stable "white" noise output having true gaussian amplitude distribution. **Frequency range:** DC to 100 KHz; **Output spectral density:** 0.01 to 1000 μV, continuously variable, calibrated; **DC offset:** less than 10 mV at max. output. **Price:** $550.

All prices shown are F.O.B. Whippany, N. J. Prices and specifications subject to change without notice.

43 SOUTH JEFFERSON ROAD, WHIPPANY, NEW JERSEY 07981 • PHONE (201) 887-5508 • TWX 710-986-8251

Representatives List

New England

VECTOR SALES, INC.
774 Pleasant St.
Belmont, Mass. 02178
617-489-1400

P.O. Box 87
Milford, Conn. 06460
203-TR 4-2112

New York State

LINDGREN ASSOCIATES
605 Palmer Drive
No. Syracuse, N. Y. 13212
315-GL 8-3113

New York City Area, New Jersey, So. Conn., Eastern Pennsylvania

L&M ASSOC. ENGRG. REPS. INC.
P.O. Box 641
Fair Lawn, N. J. 07411
201-843-8700

965A Bristol Pike
Andalusia, Pa. 19020
215-639-3100

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PADDOCK-JOSLOW COMPANY
P.O. Box 192
Silver Spring, Md. 20907
301-589-6554

Illinois, Indiana, Iowa, Wisconsin, Minnesota

KENNETH W. MEYERS CO.
7256 W. Touhy Avenue
Chicago, Illinois 60648
312-774-6440

4725 Excelsior Blvd.
Minneapolis, Minn. 55416
612-920-7080

Ohio, Michigan, Western Pennsylvania, Kentucky, West Virginia

COMPONENTS ENGINEERING CO.
7461 N. Linden Lane
Cleveland, Ohio 44130
216-842-2737

11820 Knollsprings Court
Cincinnati, Ohio 45246
513-825-8686

N. & S. Carolina, Tennessee, Alabama, Georgia, Florida, Mississippi, Louisiana,

ROY ATTAWAY CO.
57 E. Robinson St.
Orlando, Fla. 32801
305-424-9983
305-424-5328

614 Nissen Bldg.
Winston-Salem, N. C. 27101
919-722-9671

900 Bob Wallace Ave.
Huntsville, Ala. 35801
205-534-2811

Texas (except El Paso) Arkansas, Oklahoma

TRUE TECHNOLOGY CO.
12016 Fieldwood Lane
Dallas, Texas 75234
214-239-7741
713-649-7874

Montana, Idaho, Wyoming, Utah, Colorado, New Mexico, Texas (El Paso area)

J. F. HURLBUT CO.
2240 South Adams Street
Denver, Colorado 80210
303-756-2046

Washington, Oregon

J. K. DOOLEY CO., INC.
4110 Stone Way N.
Seattle, Washington 98103
206-ME 2-1618

Northern California

JAY STONE & ASSOCIATES
140 Main St.
Los Altos, Calif. 94022
415-WH 8-4563

Southern California, Arizona

A-F SALES ENGINEERING INC.
94 So. Los Robles Ave.
Pasadena, Calif. 91101
213-MU 1-5631
213-SY 5-7081

Canada

ATLAS INSTRUMENT CORP.
50 Wingold Ave.
Toronto 19, Ontario
416-781-6174

3333 Cavendish Blvd.
Suite 390
Montreal, Quebec
514-HU 9-8495

342½ Elgin St.
Ottawa, Ontario
613-CE 3-9471

10204- 88th St.
Edmonton, Alberta
403-424-9065

ALL Export (Except Canada)

SYLVAN GINSBURY, LTD.
72 West 45th Street
New York, N. Y. 10036
212-MU 7-3213

Quan-Tech LABORATORIES, INC.

TRACKING WAVE and SPECTRUM ANALYZER

Model 305

- Frequency range 10 Hz to 50 KHz.
- Selection of three constant bandwidths: 10, 100, and 1000 Hz. Also broadband, 10 Hz to 65 KHz.
- Electronic tuning: manual, internal automatic sweep, or external.
- AFC, automatic tracking, or search and track modes.
- Amplitude, frequency, and phase analog outputs, also BFO and restored signal.

The **Model 305** is an extremely versatile multi-purpose instrument. Radically new designs and the use of integrated circuits permits one compact unit to combine the functions and measuring capabilities of much larger, more complex and costly systems. It is not only useful as a standard wave analyzer for harmonic measurements and Fourier analysis of complex signals, but its three selectable flat-top bandwidths make it ideally suited for spectral density analysis of random signals.

The **Model 305** features electronic tuning, using an extremely stable and precise voltage controlled oscillator. A 5000 division linear scale is provided for manual tuning. A six position MODE switch controls the tuning functions of the **Model 305.** In the OFF position the instrument acts as a normal, manually tuned wave analyzer. In the AFC position the analyzer will lock onto a drifting signal and follow it over a limited frequency range determined by the bandwidth. In the TRACK position, the instrument will lock onto a signal and follow it over the whole or discrete portions of the tuning range. In the SWEEP position the analyzer will start at the frequency to which the tuning dial is set, and scan upward in frequency over the whole or discrete portions of the tuning range, as determined by a sweep increment switch. In the SEARCH & TRACK position, the instrument will scan as in the SWEEP position until it finds a signal, whereupon it will lock onto the signal and track it as in the TRACK position. If the signal disappears, the analyzer will continue to scan automatically until the original signal or a new one appears. Since the sweep time, sweep increment, averaging time, and bandwidth are interdependent, a red light will appear if the various switches are set to a combination which would lead to erroneous results. With the MODE switch in the EXT position, the instrument may be tuned by an external DC voltage.

Two or more **Model 305's** may be connected together without modification to form a multi-channel, phase locked, master-slave analyzer system suitable for mechanical impedance and transfer function analysis.*

A multiplicity of outputs greatly increases the versatility of the **Model 305.** When used with an X-Y plotter, it can automatically make an amplitude vs. frequency or amplitude-phase plot of the characteristics of an electronic or electromechanical system. The **Model 305** when used with an oscilloscope, X-Y plotter, or strip-chart recorder becomes a spectrum analyzer whose center frequency, sweep width, and resolution can all be varied over wide limits. Averaging time, bandwidth, and sweep speed can be selected for optimum results in random signal analysis.

***Accessory Model 1305 Slave Filter and Phasemeter.** In multi-channel installations where the slaved units never need to work independently, we recommend the **Model 1305** which has a built-in phase meter but no tuning or sweep features. Mechanical impedance and transfer function analysis is simplified and at a considerable saving in cost.

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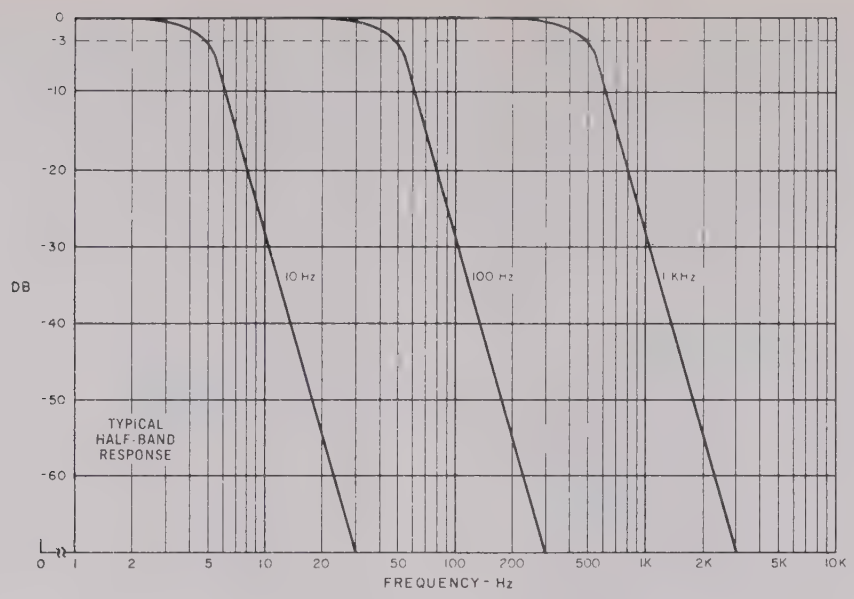

SPECIFICATIONS

FREQUENCY
Range: 10 Hz to 50 KHz
Accuracy: ±0.5% or 10 Hz
Dial: Linear, 10 Hz per division

SELECTIVITY
Three pass bands, 10 Hz, 100 Hz, and 1000 Hz at 3 db down, selectable by front panel switch. Maximally flat (Butterworth approximation) with 24db roll-off. Also broadband 10 Hz to 65 KHz.

SENSITIVITY
Range: 30μV to 300 volts full scale in 10db steps. Also variable gain control of 20db.
Dynamic Range: >70db for Fourier analysis, >40db for random signal analysis.
Accuracy: ±5%

INPUT IMPEDANCE
1 Megohm

AVERAGING TIMES
Approximately <0.1, 1, and 10 seconds, switch selectable.

TUNING MODES
Manual, Manual plus AFC, Track, Sweep, Search and Track, External.

A.F.C.
Will hold over approximately 4 bandwidths.

TRACK
Increment: ±0.5, 1, 5, 10, or 50 KHz from dial setting, switch selectable.
Threshold: Adjustable from approx. 2% to 50% of full scale.

SWEEP
Time: 0.5, 5, 50, or 500 seconds, switch selectable.
Increment: 0.5, 1, 5, 10, or 50 KHz, switch selectable.
Modes: Single or repetitive, with reset.

OUTPUTS ON FRONT PANEL
Sweep Analog: 0 to +5 volts for any sweep increment.
Amplitude Analog: 0 to 10 volts proportional to meter deflection.
BFO: Sine wave output at the frequency to which the instrument is tuned. Variable to at least 1 volt RMS into 600 ohms.
Restored Frequency: A replica of the input signal filtered in accordance with tuning and bandwidth. Variable to at least 0.5 volt RMS into 600 ohms for full scale.
Note: Either BFO or Restored output is selected by a switch. Simultaneous BFO and Restored available as an option.

AVAILABLE AT REAR CONNECTOR
Same outputs as on front panel, plus:
Frequency Analog: DC output proportional to the frequency to which the instrument is tuned +0.1mv/Hz, +5V max.
External Sweep Input: ±5V max. for ±sweep increment from dial setting.
Phase Outputs: In-phase and quadrature components, each equal to at least 5 volts peak-to-peak for full scale deflection.
Master-Slave Connections: 100 KHz crystal controlled, 100 to 150 KHz variable.
External Battery Connections: Plus, minus, and ground.

POWER INPUT
117/234 VAC, 50 to 400 Hz, 18 Watts.
or plus and minus 28VDC at 300 ma.

DIMENSIONS
11-1/16" X 15" X 11-1/4". Weight 26 lbs.

PRICE, FOB WHIPPANY, N. J.
$2550 Bench Model
$2580 Rack Mount

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MODEL 1305
ANALYZER AND PHASEMETER

The Model 1305 is an accessory unit for use with the Model 305 Tracking Wave and Spectrum Analyzer in multi-channel phase locked analyzer systems. It has the same amplitude and selectivity characteristics as the Model 305, but its tuning is controlled entirely by the latter. A phasemeter is included for reading the phase difference between the filtered signals from the master Model 305 and the slave Model 1305. Up to ten Model 1305's can be driven by a single Model 305, permitting the determination of mechanical impedance and transfer functions at a number of points simultaneously. The master-slave combination also lends itself ideally to many aspects of electronic, bio-physical, and underwater sound measurements.

FREQUENCY
Range: 10 Hz to 50 KHz controlled by Model 305

SELECTIVITY
Three pass bands, 10 Hz, 100 Hz, and 1000 Hz at 3 db down, selectable by front panel switch. Maximally flat (Butterworth approximation) with 24 db roll-off. Also broadband 10 Hz to 65 KHz.

SENSITIVITY
Range: 30 uV to 300 volts full scale in 10 db steps. Also variable gain control of 20 db.
Dynamic Range: $>$70 db for Fourier analysis, $>$40 db for random signal analysis.
Accuracy: $\pm$ 5%

INPUT IMPEDANCE
1 Megohm

AVERAGING TIMES
Approximately $<$ 0.1, 1, and 10 seconds, switch selectable.

PHASE METER
Range: 0 to $\pm 180^\circ$. An additonal 180° phase shift may be switched in for convenience when reading near $\pm 180^\circ$.
Accuracy: $\pm$1% $\pm$1 degree.

OUTPUTS ON FRONT PANEL
Amplitude Analog: 0 to 10 volts proportional to meter deflection.
Restored Frequency: A replica of the input signal filtered in accordance with tuning and bandwidth. Variable to ar least 0.5 volt RMS into 600 ohms for full scale.
Phase Meter Analog: 0 to $\pm$ 10 volts corresponding to 0 to $\pm 180^\circ$.

AVAILABLE AT REAR CONNECTOR
Same outputs as on front panel, plus:
Phase Outputs: In-phase and quadrature components, each equal to at least 5 volts peak-to-peak for full scale deflection.
Master-Slave Connections: 100 KHz crystal controlled, 100 to 150 KHz variable from Model 305.
External Battery Connections; Plus, minus and ground.

POWER INPUT
117/234 VAC, 50 to 400 Hz, 12 watts or plus and minus 28 VDC at 200 ma.

PRICE: $1850.00 FOB Whippany, New Jersey

IMPULSE DISTRIBUTION ANALYZER

Model 318

- Frequency Range DC to 15 MHz
- Pulse height and width analysis
- Four input channels
- Data storage with digital readout

The **Model 318** is intended to measure the amplitude and width of random or repetitive pulses and store the number of times that pulses of certain preselected amplitude or width characteristics occur in a given time.

The **Model 318** is designed primarily to measure interference on data transmission channels caused by cross modulation. Such interference, if it falls within certain amplitude and width limits, may be interpreted as data by the receiving apparatus, thus introducing error. By monitoring a data channel that is not being used, the **Model 318** will count the number of pulses that could be interpreted as data. By transmitting a known pulse train, the instrument can determine the number of additional error pulses that are generated in the channel.

Other applications of the **Model 318** include the analysis of pulses from nuclear and other detectors, nerve and other impulses in biophysical research, and checking used computer tape for noise pulses. Since the response of the instrument extends down to DC, it can be modified to analyze pulses of much longer duration.

The **Model 318** contains four input channels, four amplitude threshold level controls, four adjustable time gates, and four memory banks. Sampling time is selectable. Data stored in any of the memory banks can be switched to a four digit visual display or presented to an external printer. The four input channels, time gates, and memory banks can be switched in various combinations to measure either amplitude alone, width alone, or both together within certain limits. Other combinations can be supplied for specific requirements. Operation of the **Model 318** is not dependent on the waveform of the impulse. Pulse width is measured from the time the waveform first exceeds a preset level until it falls below the same level.

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SPECIFICATIONS

FREQUENCY RESPONSE: DC to −3 db at 15 MHz

SIGNAL AMPLITUDE ANALYSIS: Four separate input channels. Adjustable threshold levels for each channel. Records the number of times threshold levels are exceeded. Will accept either positive or negative or both positive and negative signals.

SIGNAL WIDTH ANALYSIS: 100 nanoseconds to 99.9 milliseconds in 4 decade ranges: 0.1 μs to 99.9 μs: 1 μs to 999 μs: 10 μs to 9.99 ms: 100 μs to 99.9 ms: Four adjustable signal width channels, switched for each decade range. Records the number of times signal width falls within $0\text{-}t_1$; $0\text{-}t_2$; $0\text{-}t_3$; $0\text{-}\infty$

SIGNAL ANALYSIS CHANNEL SWITCHING:

Position 1 — Channel 1; Four adjustable amplitude levels.
Records number of times individual levels are exceeded.

Position 2 — Channel 1; Two adjustable amplitude levels.
Records number of times individual levels are exceeded.
Channel 2; Two adjustable amplitude levels.
Records number of times individual levels are exceeded.

Position 3 — Channel 1;
Channel 2;
Channel 3;
Channel 4;
} Records number of times its selected amplitude level is exceeded.

Position 4 — Channel 1; Four adjustable time gates.
Records number of times signal width is within $0\text{-}t_1$; $0\text{-}t_2$; $0\text{-}t_3$; $0\text{-}\infty$ and exceeds a selected amplitude level.

Position 5 — Channel 1; Three amplitude levels and one width channel.
Records number of times individual amplitude levels are exceeded.
Records number of times widths are between t_1 and t_2 and amplitudes between level 1 and level 2.

INPUT IMPEDANCE: 75 ohms, 135 ohms, 600 ohms: switch selected.

INPUT AMPLITUDE THRESHOLD LEVEL: −10 dBm to −60 dBm. Adjustable in 10 dBm steps plus 10 dBm variable; positive or negative; also positive and negative inputs.

75 ohms = 275μV to 86 MV
135 ohms = 375μV to 118 MV
600 ohms = 775μV to 248 MV

SAMPLING TIMES: 1 sec, 1 min, 1 hour; single or repetitive sampling; manual timing; Ext. program.

DATA STORAGE: Recorded data stored in four memory banks.

DATA READOUT: Four digit visual readout. May be switched to any memory bank.

OVER RANGE: Digital indication when counts have exceeded 9,999.

DATA PRINT OUT: Automatically at 1 hour intervals or manual control. BCD output for printer drive.

INTERNAL CALIBRATOR: 1.0 microsecond pulses at 30 cycle PRF. Amplitude −40 dBm.

WEIGHT: 42 pounds

POWER INPUT: 117/234 VAC.

DIMENSIONS: 19" wide x 10½" high.

PRICE: $4500.00 FOB Whippany, New Jersey

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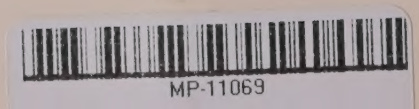
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